Mountains to Cajon Pass. Cleghorn Mountain is an asymmetric bulge or arch raised on the south along the Cleghorn fault and tilted westward to Cajon Pass and northward to the Mohave Desert. Its structure is typical of all the western part of the San Bernardino Mountain mass in view toward the east, essentially a succession of crustal blocks, each of which is tilted north and is raised on the south along a northward-dipping reverse fault. (See section A, pl. 3.) The mass as a whole was raised by compression. Inasmuch as it is composed of massive crystalline rocks the deformation has resulted in reverse faults, shearing, arching, and tilting. If it had been composed of sedimentary rocks the same deformation would have resulted in folding and thrusting.

Other evidence of arching in the region is plainly visible in the parallel ridges of the San Andreas fault zone, whose even crests descend steadily for many miles to the lower canyon of Cajon Creek and the San Bernardino Plain.

ASPHALT DEPOSITS AND QUATERNARY LIFE OF RANCHO LA BREA

By Chester Stock

The name Rancho La Brea was applied originally to a Mexican land grant in the vicinity of Los Angeles, but as now generally understood it refers to an area of approximately 32 acres (13 hectares) on Wilshire Boulevard a few miles west of the heart of the city. The unique paleontologic features of this locality were first fully appreciated a quarter of a century or more ago.

The asphalt beds, which have resulted from a penetration and exudation of oil, form part of a terrestrial accumulation of clay, sand, and rubble. These superficial deposits retain a horizontal position, are several hundred feet in maximum thickness, and rest upon an eroded surface formed on folded and presumably faulted marine strata of Tertiary and Pleistocene age, elsewhere exposed in the Los Angeles Basin. Structural features facilitated an upward movement of petroliferous material from the oil sands of the older rocks, and the outpours or seeps occurred concomitantly with the deposition of the superjacent formation. Minor quantities of gas and oil still reach the surface, but the activity of the seeps has diminished considerably, even in historic time.

Excavations by the Los Angeles Museum have shown that the fossiliferous asphalt of the Pleistocene outpours varies con-

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siderably in lateral and vertical extent. The masses lie close to the present surface and extend downward to a depth of 15 to 35 feet (4.5 to 10.6 meters). Not only did the outpours accumulate in the hollows of an irregular land surface, but some exudations were accompanied perhaps by sufficient force to form craterlike depressions into which the tar and oil subsequently flowed.

The trapping of rodents and birds by seeps occurring to-day presents in a graphic way the method by which the larger outpours of the Pleistocene caught the animals and plants of that time. Accumulating in a region where life abounded, the tar pools doubtless frequently entrapped creatures who in their movements through this region unwittingly came into contact with the sticky mass. More than 100 species of plants and animals have been described from these deposits.

The cries and struggles of a mired animal doubtless lured other creatures to the traps, and among those frequently caught were the flesh eaters. That the carnivores often succumbed is clearly manifested by the fossil record. A census of the mammals indicates that over 90 per cent belong to predatory groups. A similar preponderance of predators is revealed by a census of the fossil birds. Among the mammals the more frequent captives were the saber-tooth (*Smilodon californicus*) and the dire wolf (*Aenocyon dirus*), both of which are represented by many hundreds of skulls and by thousands of skeletal elements. Also included in the assemblage are the great lionlike cat (*Felis atrox*), the coyote (*Canis ochropus orcutti*), and the short-faced bear (*Tremarctotherium californicum*). Among the characteristic herbivores are the mammoth (*Archidiskodon imperator*), mastodon (*Mammut americanum*), horse (*Equus occidentalis*), bison (*Bison antiquus*), camel (*Camelops hesternus*), antelope (*Capromeryx minor*), and several kinds of ground sloths (*Mylodon harlani*, *Nothrotherium shastense*, and *Megalonyx jeffersonii*).

Birds are likewise well represented, and the assemblage as a whole is more varied than the mammalian group. Among these the falconlike birds constitute the dominant division, including the largest bird of flight, a condorlike vulture (*Teratornis merriami*), and great numbers of condors, vultures, eagles, and hawks. Next to the Falconiformes the largest group are the gallinaceous birds, of which the principal representative is a turkey (*Parapavo californicus*).

The animals specifically mentioned above are extinct, but the fauna includes also living species. Many mammals and birds of the Rancho La Brea fauna are identical with or closely related to species found elsewhere in North American Pleistocene deposits. The faunal stage represented by the collections

obtained in the larger excavations conducted by the Los Angeles Museum appears to be a homogeneous one, dating probably from some period within the last half of the Pleistocene. Certain pits or excavations, notably pit 10, have yielded material, including human remains, evidently belonging to a later stage.

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GENERAL GEOLOGY OF THE LOS ANGELES BASIN

By H. W. HOOTS

The city of Los Angeles lies along the northern border of a broad plain that is flanked on the west and south by the shores of the Pacific and on the north, northeast, and east by ranges of hills and mountains. At the southwest corner of this plain a prominent topographic feature known as the San Pedro Hills projects into the ocean and appears to protect by its resistant rocks much of the plain from destruction by marine abrasion. From the accompanying map (pl. 6) it is apparent that this low plain, though not completely surrounded by high areas, has some of the characteristics of a topographic basin. Geologically this basin, commonly called the Los Angeles Basin, is a broad syncline that, beneath its surface veneer of alluvium, contains as its upper strata 5,000 to 10,000 feet (1,500 to 3,000 meters) of marine Pliocene and Pleistocene rocks and is bordered by elevated and intricately folded and faulted areas of rocks ranging in age from Triassic to Pliocene that have an aggregate thickness of 25,000 to 40,000 feet (7,600 to 12,200 meters). These adjoining upland areas received most of their present elevation as a result of crustal movements during the Quaternary period—movements so recent that hills and mountains still retain remnants of old geomorphic surfaces that were carved during late Pliocene and Pleistocene time, when these areas were much lower with reference to the sea.

The Los Angeles Basin is not a simple syncline; it is crossed by northwestward-trending lines of anticlinal folding and faulting that have transformed this broad basin into a geosyncline. (See figs. 1, 2.) This deformation also occurred in Quaternary time, and as a result most of these interbasin anticlines and faults are expressed at the surface by elongated low hills of late Pleistocene rocks broken or approximately paralleled

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